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Savannah Mandel

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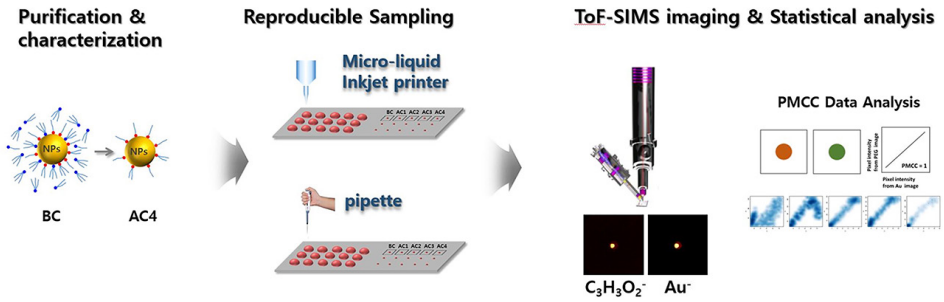
Using a micro-liquid inkjet printer and time of flight secondary ion mass spectrometry imaging, researchers observe step by step surface modification of nanoparticles for biomedical applications.



Nanoparticles must be modified with ligands for in vivo biological applications in order to prevent their conglomeration due to high surface energy. The multi-step process of surface modification is crucial to successful use of the nanoparticles and can involve toxic compounds. Shon et al. developed a method for monitoring nanoparticle surfaces throughout each step of the ligand binding procedure in an effort to produce more stable particles.

“A method to evaluate the ligand binding status for each step is necessary to identify whether the toxic compounds used during the procedure are remaining at the end of the final step,” said author Hyun Kyong Shon. “Our method verifies that the surfaces of the nanoparticles are properly substituted with the adequate ligands.”

The authors used a micro-liquid inkjet printer for quick and uniform sample preparation. Once images of the nanoparticles were taken with time of flight secondary ion mass spectrometry, they added smoothing and binning measures to the data to increase the image contrast.

“Adding smoothing and binning procedures during the image processing steps enabled evaluation of ligands present on the surface of nanoparticles,” said Shon.

They tested their method on gold nanoparticles (AuNPs), which are commonly used for medical applications due to their exceptional biostability, and polyethylene glycol (PEG) ligands. Unusually, the authors found excessive free ligands in the nanoparticle solution, which needed to be removed before the surface of the nanoparticles could be studied.

“The aim of this study was to evaluate PEGylated AuNPs. However, we expect our method can be applied to various nanoparticles,” said Shon.

Source: “Numerical evaluation of polyethylene glycol ligand conjugation gold nanoparticle surface using ToF-SIMS and statistical analysis,” by Hyun Kyong Shon, Jin Gyeong Son, SunHo Joh, Jeong Hee Moon, and Tae Geol Lee, *Biointerphases* (2020). The article can be accessed at https://doi.org/10.1116/6.0000106.